



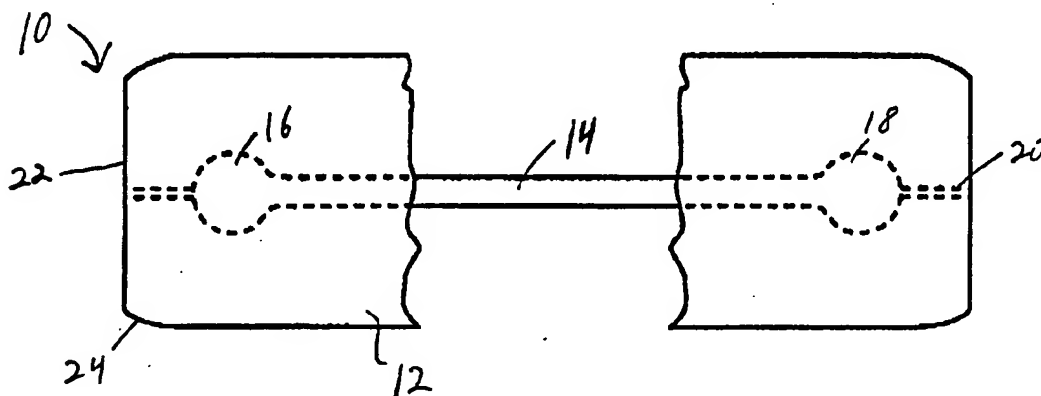
PCT

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(54) Title: FLEXIBLE FOAM CONSTRUCTION TOY AND METHOD OF MANUFACTURING SAME



(57) Abstract

A flexible foam construction toy (10), comprising: an elongated foam body (12) having a central aperture (20) with a first diameter; a flexible wire (14), with a second diameter approximately equal to the first diameter, $\pm 20\%$, and located along the central aperture (20) of the foam body (12) such that its ends (16, 18) are within a distance no greater than the diameter of the foam body (12) (or the diameter of the largest circle that can be drawn completely within a non-cylindrical foam body) from either end of the foam body (12); and adhesive between the wire (14) and the foam body (12) for assisting to maintain the wire (14) within the foam body (12).

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FLEXIBLE FOAM CONSTRUCTION TOY
AND METHOD OF MANUFACTURING SAME

FIELD OF INVENTION

This invention relates to a flexible foam construction toy that can be bent in a variety of shapes.

BACKGROUND OF INVENTION

One type of child's construction toy is a type which consists of a number of interconnectable pieces. Often these pieces are rigid. Sometimes the pieces have the interconnection structures built therein, and other times there are separate pieces that act to interconnect other pieces. Although these rigid toy pieces have great variety, the child is limited by the particular size and shape of the pieces of the construction toy set.

Some such interconnectable construction toy sets use flexible pieces. One such toy uses plastic-coated wire pieces with special end designs which allow the pieces to be interconnected. Even this limits the child's use of the toy, however, as the pieces are not adapted to be interconnected at places other than their ends. Additionally, the relatively thick wire and relatively dense plastic coating are sufficiently massive that they effectively limit the size of the toy pieces.

SUMMARY OF INVENTION

It is therefore an object of this invention to provide a construction toy which can be used to make virtually any shape of any size.

It is a further object of this invention to provide such a construction toy in which the toy pieces can be interconnected anywhere along their lengths.

It is a further object of this invention to provide such a construction toy in which the toy pieces can be directly interconnected, or interconnected with separate interconnection pieces.

It is a further object of this invention to provide such a construction toy in which the pieces are extremely light so that they can be made very large and/or long.

This invention results from the realization that a superior construction toy may be accomplished by making different toy shapes out of extruded foam with a relatively thin,

1 flexible wire inserted in a central aperture in the foam piece and held therein with
2 adhesive and with enlarged ends which inhibit piercing of the foam by the wire ends.

3 This invention features a flexible foam construction toy, comprising: an elongated
4 foam body having a central aperture with a first diameter; a flexible wire, with a second
5 diameter approximately equal to the first diameter, $\pm 20\%$, and located along the central
6 aperture of the foam body such that the wire ends are each within a distance no greater
7 than the diameter of the foam body (or the diameter of the largest circle that can be
8 drawn completely within a non-cylindrical foam body) from either end of the foam body;
9 and adhesive means between the wire and the foam body for assisting to maintain the
10 wire within the foam body. The wire may include enlarged ends, with a third diameter
11 greater than the second diameter. The enlarged ends may be integral with the wire, or
12 may be separate structures bound to the ends of the wire. The wire is preferably
13 aluminum, and may be 0-temper aluminum.

14 The adhesive means may include heat, glue, epoxy, heat activated adhesive or
15 other adhesives. The foam body may be made from polyurethane or polyethylene with
16 or without additives. The ends of the foam body may be sealed or capped to assist in
17 keeping the wire in the aperture. The wire may have a diameter between $1/32"$ and $1/2"$.
18 The size of the wire adheres to the following principal: The ratio of the foam OD to the
19 diameter of the wire will range from 4:1 to 20:1 for a 2.5 lb per cubic foot (pcf) foam.
20 The upper range of this ratio will change as the foam density changes by a factor of:
21 $2.5/\text{density of foam used}$. For example a 1.25 lb pcf foam would have the ratio of 4:1
22 to $2.5/1.25 \times 20:1$ or 40:1. A 5 lb pcf foam would have the ratio of 2:1 to 10:1. In the
23 case of non-cylindrical bodies, the measurement used for this ratio should be the diameter
24 of the largest circle that can be drawn completely within the figure.

25 In a more specific embodiment, this invention features a flexible foam
26 construction toy, comprising: an elongated foam body having a central aperture with a
27 first diameter, and sealed ends; a flexible wire, with a second diameter of at least $1/32"$,
28 and approximately equal to the first diameter, $\pm 20\%$, and located along the central
29 aperture of the foam body; enlarged wire ends fixed to or integral with both ends of the
30 wire, and ending within a distance no greater than the diameter of the foam body (or the
31 diameter of the largest circle that can be drawn completely within a non-cylindrical foam
32 body) from either end of the foam body; and adhesive between the wire and the foam

body for assisting to maintain the wire within the foam body.

Also featured is a method of manufacturing a flexible foam construction toy, comprising the steps of: extruding an elongated foam shape, having a central aperture with a first diameter; providing a piece of flexible wire; substantially coating the wire or the internal aperture of the foam with an adhesive; inserting the wire into the central aperture of the foam shape so that the wire is within the foam shape; and closing off the ends of the foam shape to assist in maintaining the wire within the foam shape. The length of the wire may be equal to that of the foam shape or shorter or longer than the foam shape by a distance no greater than the diameter of the foam body (or the diameter of the largest circle that can be drawn completely within a non-cylindrical foam body). The method may further include the step of enlarging the wire ends before insertion into the foam shape, which may be accomplished by balling the wire at its ends, or by fixing enlarged structures to the ends of the wire. If a heat activated adhesive is used, it can be reactivated by heating with hot air, or by heating the metal wire with rf induction.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects features and advantages will occur to those skilled in the art from the following description of preferred embodiment, and the accompanying drawings, in which:

Fig. 1 is a side view of one form of a flexible foam construction toy according to this invention with a portion of the toy removed to detail the interior structure;

Fig. 2 is an end view of the toy of Fig. 1;

Fig. 3 is a partial cross sectional view of the toy of Fig. 1;

Fig. 4 is a view similar to that of Fig. 1 for another style of flexible foam construction toy according to this invention;

Fig. 5 is an end view of the toy of Fig. 4;

Fig. 6 is a partial cross sectional view of the toy of Fig. 4;

Fig. 7 is a cross-sectional view of another embodiment, detailing a manner of closing off the end of the foam body with a cap;

Figs. 8A through 8D are an unbent and three bent shapes, respectively, of a flexible foam construction toy according to this invention having a circular cross section;

Figs. 9A through 9D are similar views for a toy having a square cross section;

1 Figs. 10A through 10D are similar views for a toy having a triangular cross
2 section;

3 Figs. 11A through 11D are similar views for a toy having a rectangular cross
4 section;

5 Figs. 12A through 12D are similar views for a toy having a rectangular cross
6 section and holes therethrough; and

7 Fig. 13 is a view of many pieces put together to form a fanciful construction.

8 DESCRIPTION OF THE PREFERRED EMBODIMENTS

9 There is shown in Figs. 1 through 3 flexible foam construction toy 10 according
10 to this invention. Toy 10 is made from an elongated foam body 12 having central
11 aperture 20 which is typically approximately 1/32" to 1/2" in diameter. The foam body
12 can take a variety of shapes as illustrated in Figs. 7 through 11, for example. Flexible
13 wire 14 having enlarged ends 16 and 18 is embedded within body 12 along aperture 20.
14 Wire 14 is preferably zero-temper aluminum wire having a thickness between 1/32" and
15 1/2". The size of the wire adheres to the following principal: The ratio of the foam OD
16 to the diameter of the wire will range from 4:1 to 20:1 for a 2.5 lb per cubic foot (pcf)
17 foam. The upper range of this ratio will change as the foam density changes by a factor
18 of: 2.5/density of foam used. For example a 1.25 lb pcf foam would have the ratio of
19 4:1 to 2.5/1.25 x 20:1 or 40:1. A 5 lb pcf foam would have the ratio of 2:1 to 10:1.
20 In the case of non-cylindrical bodies, the measurement used for this ratio should be the
21 diameter of the largest circle that can be drawn completely within the figure. Enlarged
22 ends 16 and 18 in this case are formed by enlarging the wire ends, for example by
23 balling the ends in a coining or molding process.

24 Toy 10 is manufactured first by extruding foam body 12 and cutting off the
25 extrusion to the desired length. The foam is preferably polyurethane or polyethylene with
26 or without additives. This material has enough flexibility to allow wire 14, including
27 enlarged ends 16 and 18, to be inserted into aperture 20. Before wire 14 is inserted in
28 the aperture, it or the aperture is coated with an adhesive such as a glue, epoxy, heat
29 activated adhesive or other adhesives to assist in maintaining the wire in place within
30 body 12. If a heat-activated adhesive is used, it can be activated by placing the toy in
31 an oven, or by heating the metal wire by rf induction.

1 It has been found that the ends of wire 14 should be within a distance equal to the
2 diameter of a cylindrical foam body, or the diameter of the largest circle that can be
3 drawn completely within a non-cylindrical foam body, from the ends of body 12. To
4 further assist in maintaining wire 14 in place and preventing it from puncturing body 12
5 or slipping out one of the ends of aperture 20, body 12 is preferably closed off after the
6 wire is inserted. If the ends are sealed, the result is that the body ends such as end 22
7 are slightly smaller than the diameter of the remainder of body 12. This sealing serves
8 to help close off the open ends of aperture 20 and may be achieved with heat, glue,
9 epoxy, heat activated adhesive, or other adhesives.

10 An alternative construction of toy 10a is shown in Figs. 4 through 6. Wire 14a
11 is provided with enlarged ends in this case by sealing or gluing caps 32 and 34 on the
12 ends of the wire. These caps may be similar to wire nuts. Another type of enlarged end
13 is made by looping the ends back on themselves. The construction may also be
14 accomplished with two half foam pieces (such as half-circular cross-section) with a
15 central channel, into one of which wire 14a is laid before the halves are adhered together,
16 leaving seam 20a.

17 Fig. 7 details another manner of closing off the ends of the foam body to prevent
18 the wire from poking out through the ends. This method can also be used to cap wire
19 ends when the wire is longer than the foam body. Wire 14b has enlarged end 35 which
20 can be formed by stamping. After wire 14b is inserted in channel 20b in the center of
21 foam body 12b, plastic end cap 37 is fitted over the end of wire 14b. Cap 37 has
22 shoulder 38 that snaps over and mates with corresponding shoulder 36 of wire 14b to
23 keep cap 37 on the end of wire 14b.

24 The foam construction toy of this invention can take any one or more of virtually
25 unlimited shapes. In manufacturing, it is advantageous to choose shapes which may be
26 extruded. One shape is a circular tube 50 through 50c, Figs. 8A through 8D. Figs. 8B
27 and 8D illustrate three of a virtually unlimited number of shapes which that toy may be
28 bent into. Similar drawings are shown for tubes 60 through 60c with a square cross
29 section, Figs. 9A through 9D; tubes 70 through 70c with a triangular cross section, Figs.
30 10A through 10D; rectangular bars 80 through 80c with a rectangular cross section, Figs.
31 11A through 11D; and rectangular bars 90 through 90c, Figs. 12A through 12D, which
32 have a rectangular cross section and include a number of through-holes such as hole 91

1 which allow this piece to be connected to the tube-shaped pieces by passing the tubes
2 through the holes.

3 Fig. 13 is a drawing of a fanciful assembly made with a number of flexible foam
4 construction toy pieces according to this invention. Rectangular base pieces 100 and 101
5 have a cylindrical hole for supporting cylindrical pieces 50d and 50e which in turn
6 support the other pieces, including rectangular bars 90a and 90b which have through
7 holes as shown, disk-shaped pieces 102 and 104 which may have holes for holding
8 cylindrical pieces such as 50q, longer cylindrical pieces 50f through 50h, shorter
9 cylindrical pieces 50i through 50p, star-shaped piece 106, triangular piece 108, and
10 sawtooth piece 110 which may have one or more holes adapted to receive another piece
11 of the set to allow the user to create myriad fanciful designs.

12 Although specific features of this invention are shown in some drawings and not
13 others, this is for convenience only as each feature may be combined with any or all of
14 the other features in accordance with the invention.

15 Other embodiments will occur to those skilled in the art and are within the
16 following claims:

17 What is claimed is:

CLAIMS

1 1. A flexible foam construction toy, comprising:
2 an elongated foam body, having a central aperture with a first diameter;
3 a flexible wire, with a second diameter approximately equal to the first
4 diameter, $\pm 20\%$, and located along the central aperture of the foam body; and
5 adhesive means between the wire and the foam body for assisting to
6 maintain the wire within the foam body.

1 2. The flexible foam construction toy of claim 1 in which the wire includes
2 enlarged ends, with a third diameter greater than the second diameter.

1 3. The flexible foam construction toy of claim 2 in which the enlarged ends
2 are integral with the wire.

1 4. The flexible foam construction toy of claim 2 in which the enlarged ends
2 are separate structures bound to the ends of the wire.

1 5. The flexible foam construction toy of claim 4 in which the structures are
2 bound to the wire ends with adhesive.

1 6. The flexible foam construction toy of claim 4 in which the structures are
2 sealed on the wire ends.

1 7. The flexible foam construction toy of claim 1 in which the wire ends are
2 within a distance equal to the diameter of the largest circle which can be included
3 completely within the foam body of the ends of the foam body.

1 8. The flexible foam construction toy of claim 1 in which the wire ends are
2 within a distance no greater than the diameter of the foam body, or the diameter of the
3 largest circle that can be drawn completely within a non-cylindrical foam body, from
4 either end of the foam body.

1 9. The flexible foam construction toy of claim 1 in which the wire is
2 aluminum.

1 10. The flexible foam construction toy of claim 9 in which the wire is 0-temper
2 aluminum.

1 11. The flexible foam construction toy of claim 1 in which the adhesive means
2 includes heat, glue, epoxy, heat activated adhesive or other adhesives.

1 12. The flexible foam construction toy of claim 1 in which the foam body is
2 made from polyurethane or polyethylene with or without additives.

1 13. The flexible foam construction toy of claim 1 in which the ends of the
2 foam body are sealed.

1 14. The flexible foam construction toy of claim 1 in which the wire has a
2 diameter between 1/32" and 1/2".

1 15. The flexible foam construction toy of claim 1 in which the ends of the
2 foam body are closed off with a cap placed over each end of the wire.

3 16. A flexible foam construction toy, comprising:
4 an elongated foam body having a central aperture with a first diameter, and
5 sealed ends;
6 a flexible wire, with a second diameter of at least 1/32", approximately
7 equal to the first diameter, $\pm 20\%$, and either located completely within the foam body
8 along its central aperture or within a distance no greater than the diameter of the foam
9 body, or the diameter of the largest circle that can be drawn completely within a non-
10 cylindrical foam body, from either end of the foam body;
11 enlarged wire ends fixed to or integral with both ends of the wire; and
12 adhesive between the wire and the foam body for assisting to maintain the
13 wire within the foam body.

14 17. A method of manufacturing a flexible foam construction toy, comprising
15 the steps of:
16 extruding an elongated foam shape, having a central aperture with a first
17 diameter;
18 providing a piece of flexible wire;

1 substantially coating the wire or the internal aperture of the foam with an
2 adhesive;
3 inserting the wire into the central aperture of the foam shape so that the
4 wire is completely within the foam shape; and
5 closing off the ends of the foam shape to assist in maintaining the wire
6 within the foam shape.

1 18. The method of claim 17 in which the wire is shorter than the foam shape
2 by between one-eighth of an inch and two inches.

1 19. The method of claim 17 further including the step of enlarging the wire
2 ends before insertion into the foam shape.

1 20. The method of claim 19 in which the enlarged wire ends are created by
2 balling the wire at its ends.

1 21. The method of claim 19 in which the enlarged wire ends are created by
2 fixing enlarged structures to the ends of the wire.

3 22. The method of claim 19 in which the enlarged wire ends are created by
4 looping the wire ends back on themselves.

1 23. The method of claim 17 in which closing off the ends of the foam shape
2 is accomplished by placing a cap, larger than the foam shape central aperture, over each
3 end of the wire after the wire is inserted into the central aperture.

1 24. The method of claim 17 in which the adhesive is heat activated, the method
2 further including the step of activating the adhesive, after the wire is inserted into the
3 central aperture, with hot air or rf induction.

FIG. 1

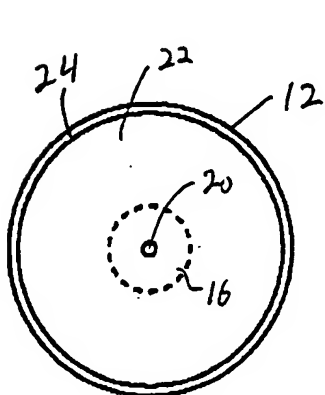
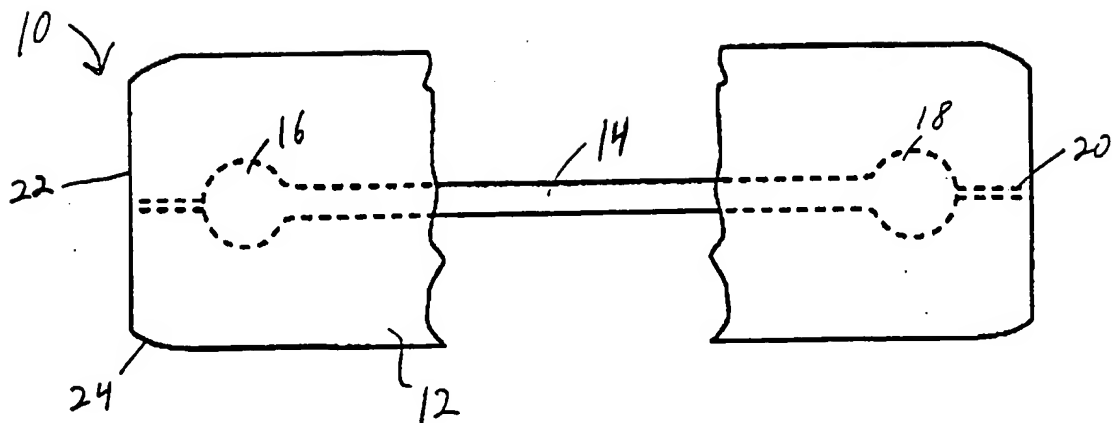


FIG. 2

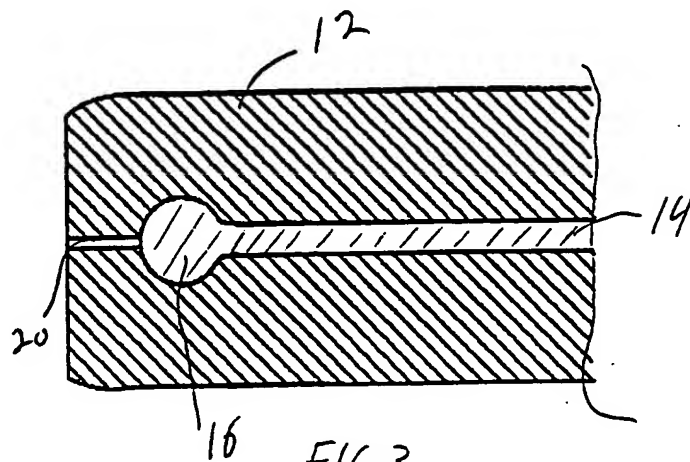


FIG. 3

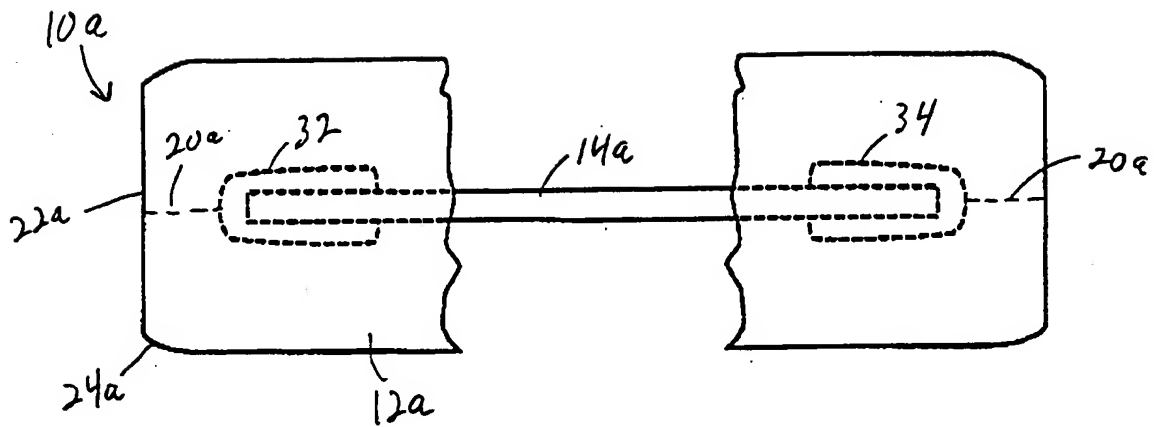


FIG. 4

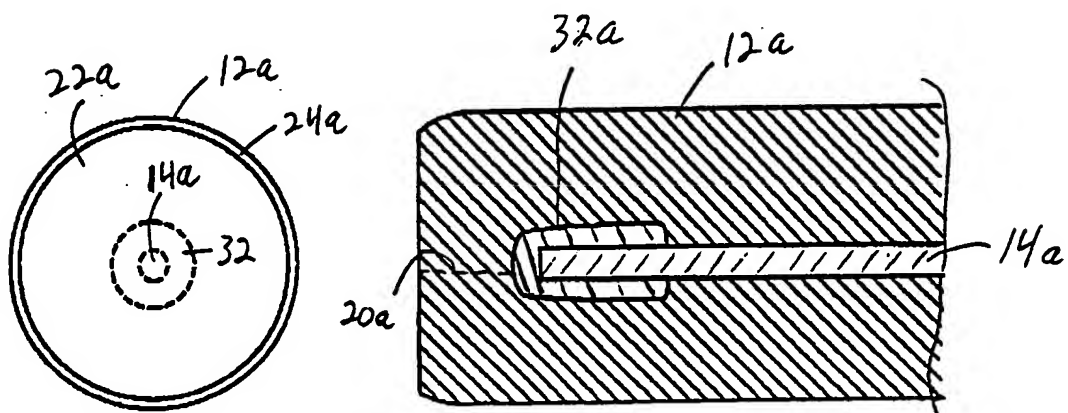


FIG. 5

FIG. 6

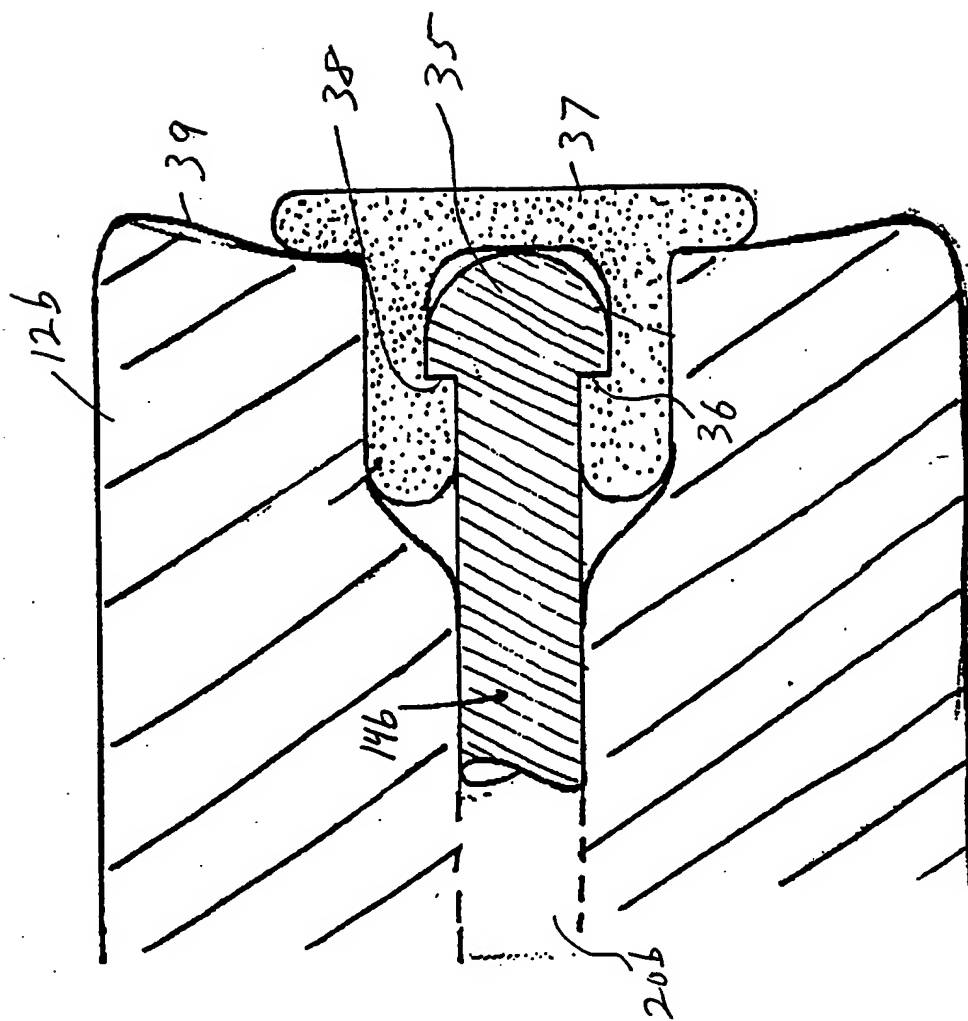


FIG. 7

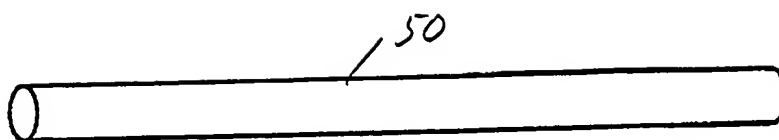


FIG. 8A

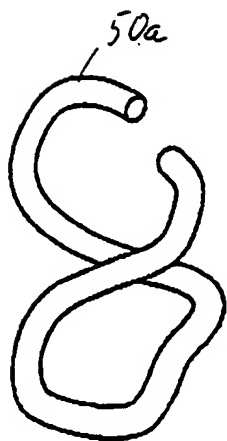


FIG. 8B

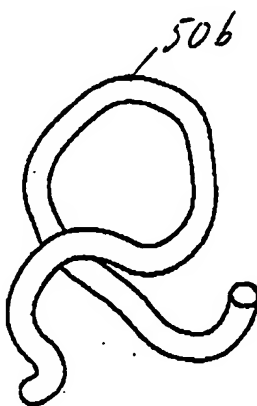


FIG. 8C

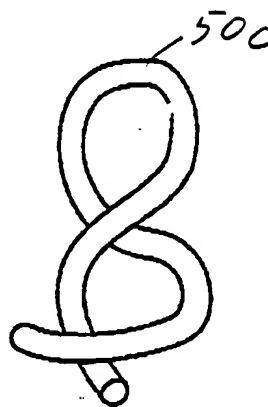


FIG. 8D

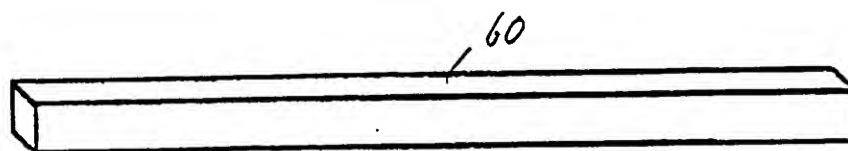


FIG. 9A

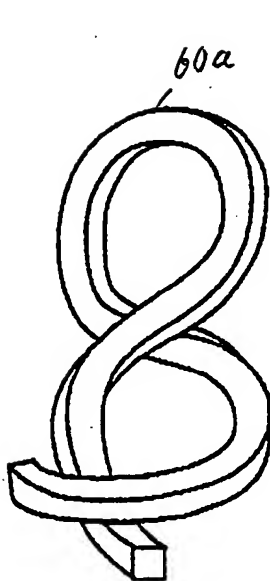


FIG. 9B

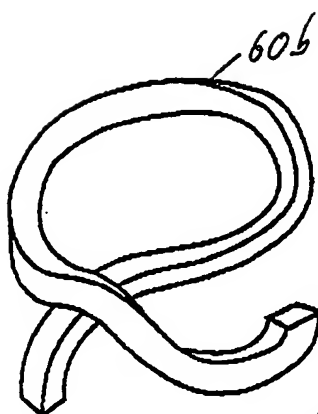


FIG. 9C



FIG. 9D

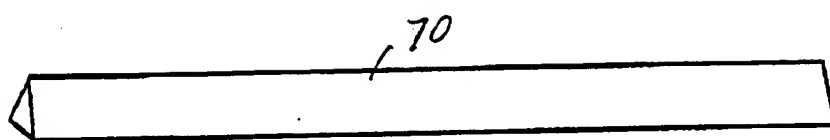


FIG. 10A

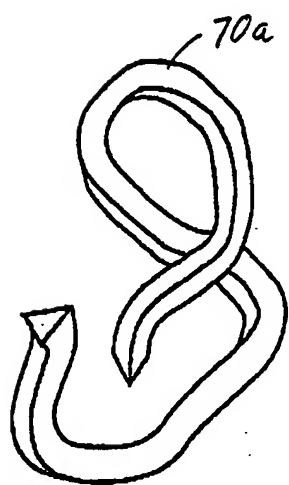


FIG. 10B

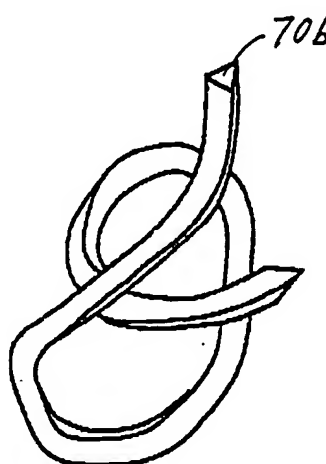


FIG. 10C

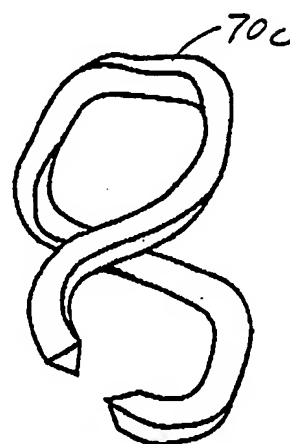


FIG. 10D

FIG. 11A

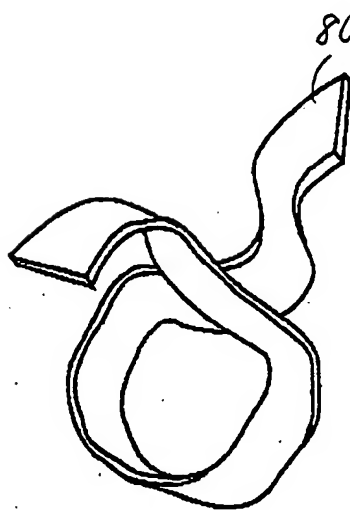
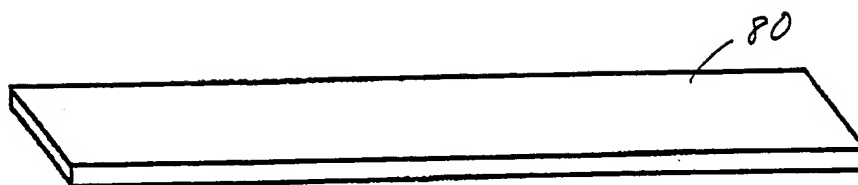


FIG. 11B

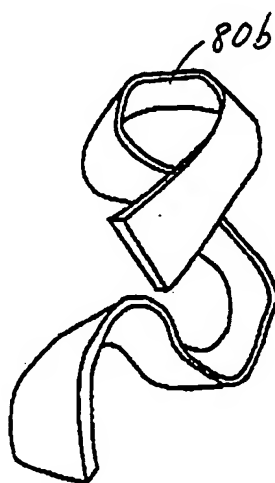


FIG. 11C

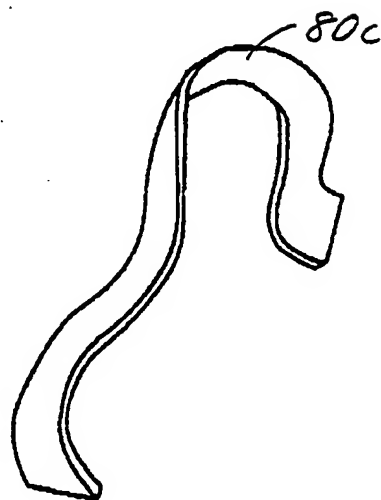
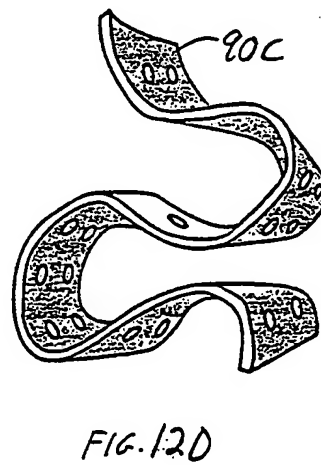
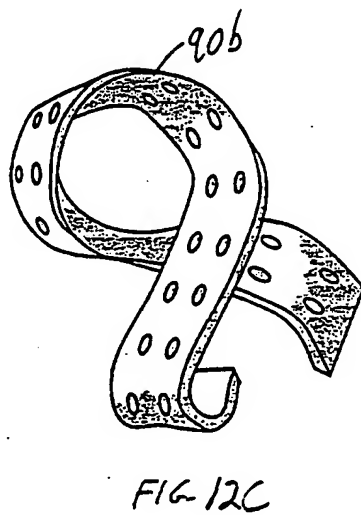
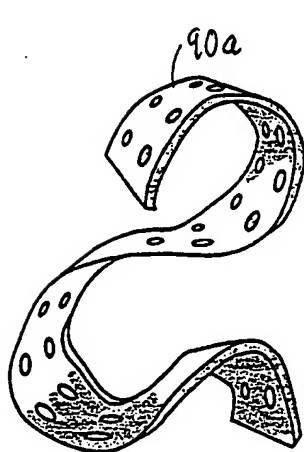
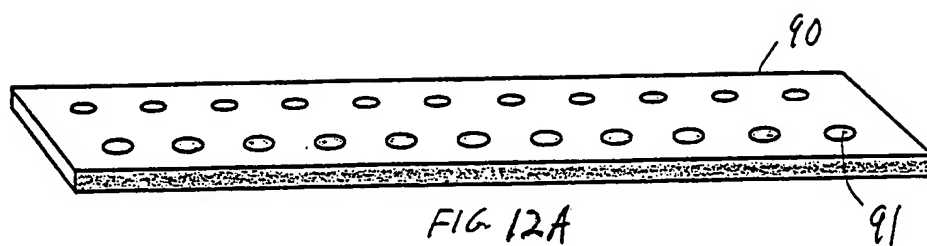


FIG. 11D



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/08055

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A63H 33/04, 33/08

US CL : 446/85, 107, 486

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 273/DIG.4, DIG. 8, 67R, 72R, 84R; 434/278, 279, 281; 446/85, 87, 107, 116, 119, 370, 373, 374, 486, 477, 490

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US, A, 4,648,414 (FOX ET AL.) 10 March 1987, see entire document.	1, 7, 8, 11-16 ----- 2-6, 9, 10, 17, 24
Y	US, A, 2,542,601 (P. VAN CLEEF) 20 February 1951, see Figs. 3-5	2, 3, 18-20, 22
Y	US, A, 3,918,196 (SCHLEICH) 11 November 1975, see Fig. 2, and column 1 line 44.	4, 6, 9, 10 21, 23
Y	US, A, 4,666,417 (HILLMAN) 19 May 1987, see column 4 line 1.	5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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